EXAMPLE PROBLEMS FOR GRAVITY:

1. What is your mass? How much do you weigh on Earth? The mass of Earth is 6×10^{24} kg and the radius of Earth is 6400 km.

   A: for m = 70kg, Fg = 684N.

2. Look up the masses and radii of other planets and calculate your weight there.

   A: for m = 70kg, Fg = 259N, 621N, 260N, 1734N, 730N, 620N, 777N for Mercury, Venus, Mars, Jupiter, Saturn, Uranus and Neptune, respectively.

3. Imagine Earth were 100 times smaller. How much would you weigh then?

   A: for m = 70kg, Fg = 6.84 million N.

4. The distance to the Moon is 384,000 km, and its mass is 7.4×10^{22} kg. Where between the Earth and the Moon would you have to be to be truly weightless?

   A: 345,617km from Earth (without accounting for the centrifugal force).

5. Look up orbital periods of all planets and compute their distances from the Sun. Compare them with what you find online.

   A: for P = 88d, 225d, 687d, 4331d, 10747d, 30589d, 59800d
   a = 0.39au, 0.72au, 1.52au, 5.2au, 9.53au, 19.14au, 29.9au.

6. Now imagine that orbital periods of all planets are exactly the same, but that the mass of the Sun is 5 times less. How far would the planets be from the Sun?

   A: a = 0.23au, 0.42au, 0.58au, 0.89au, 3.04au, 5.57au, 11.2au,17.5au.

7. Let's say that the Sun is 20 times more massive than it is. How would that affect the length of a year if Earth was at the same distance?

   A: P = 81.8 days (0.22 years).

8. Keep the Sun at 20 times its actual mass. If Earth was to complete its orbit in 1 year, at what distance would it need to be?

   A: a = 2.71au.

9. We discover a planet around a star that orbits it every 12 years. We then measure the distance between that star and that planet to be 3 astronomical units. What is the mass of the star?

   A: $M = 0.19\ M_{Sun}$ (3.76×10^{29} kg).

10. Gravitational acceleration on Earth is 9.8 m/s^2. Where does that number come from?

    A: $Fg = (GmM_{Earth}/R^2) = mg \rightarrow g = GM_{Earth}/R^2 = 9.8\ m/s^2$.